

Ecosystem & Socioeconomic Profile: EBS Pacific Cod Report Card

Kalei Shotwell, November Groundfish Plan Team 2023



Editor: S. Kalei Shotwell

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Overview

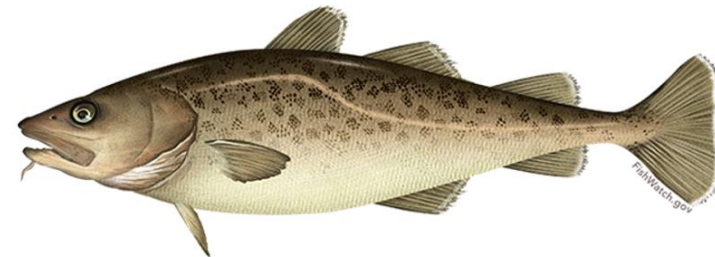
- Appendix 2.2 in SAFE Report
 - Draft and full ESP in 2020-2021
 - Report Card in 2021-2023
- Report Card in 2023
 - Simplified report with current data
 - Ecosystem and socioeconomic indicator assessment and analysis
 - 6 team, 21 contributors

Appendix 2.2 Ecosystem and Socioeconomic Profile of the Pacific cod stock in the Eastern Bering Sea - Report Card

S. Kalej Shotwell (Editor)

Steve J. Barbeau, Tom Hurst, Ben Laurel, Krista Oke, Lauren Rogers, and Elizabeth Siddon (Team)

November 2023



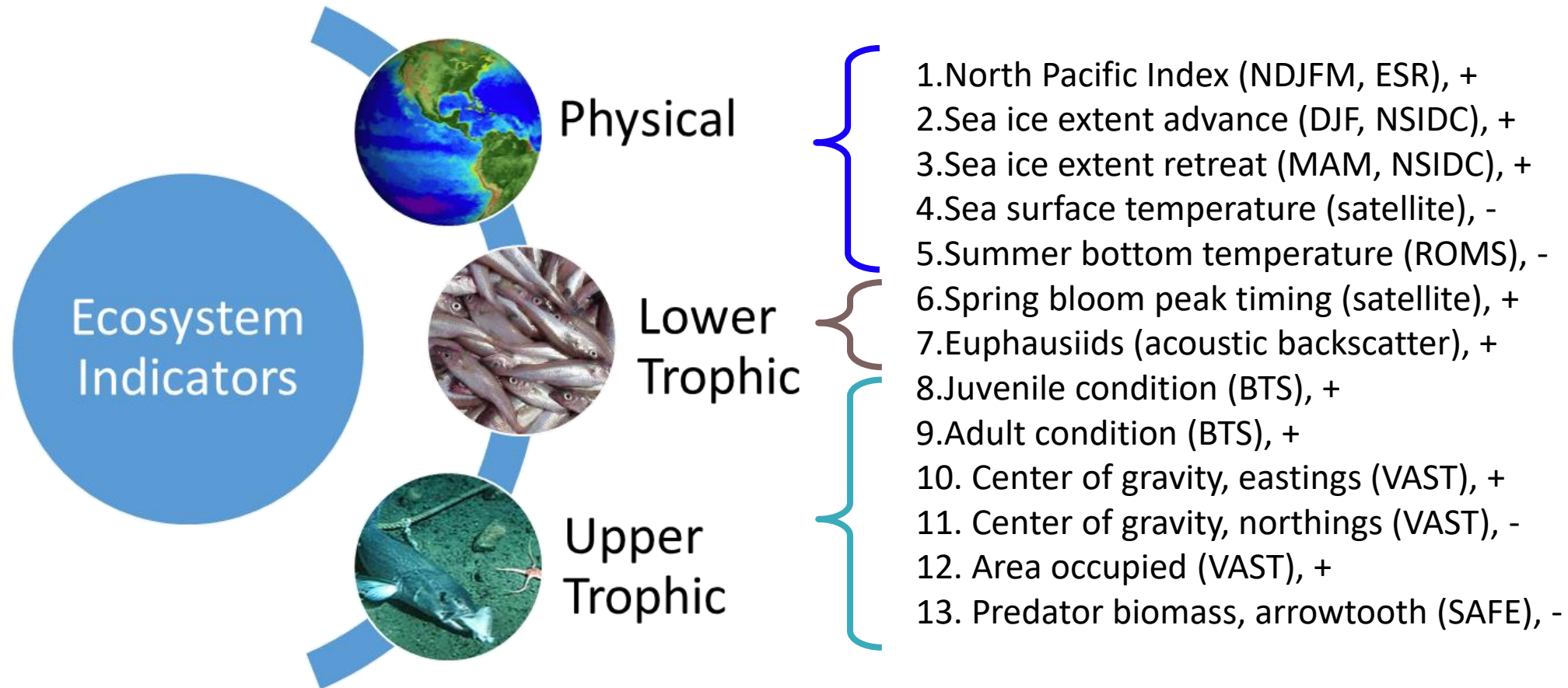
Appendix 2.2

With Contributions from:

Anna Ableman, Grant Adams, Kerim Aydin, Matt Callahan, Curry Cunningham, Bridget Ferriss, Brian Garber-Yonts, Madison Hall, Kirstin Holsman, Kelly Kearney, Jean Lee, Beth Matta, Sandi Neidetcher, Jens Nielsen, Patrick Ressler, Heather Renner, Sean Rohan, Kalej Shotwell, Elizabeth Siddon, Katie Sweeney, Muyin Wang



Ecosystem Indicators



Ecosystem Summary Table

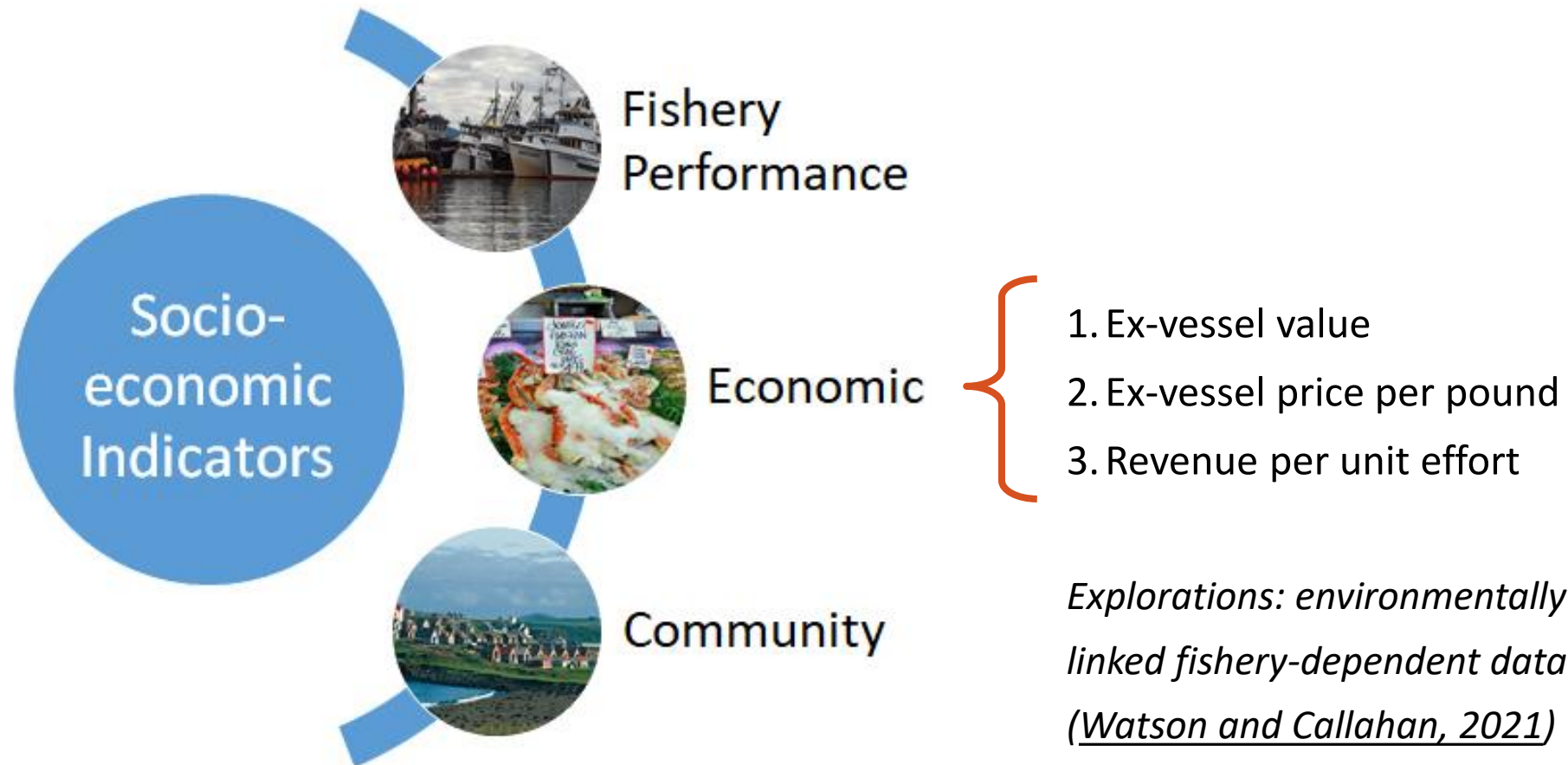
Category	Indicator	2019 Status	2020 Status	2021 Status	2022 Status	2023 Status
Physical	Winter Spring North Pacific Index Model	neutral	<i>high</i>	neutral	neutral	<i>high</i>
	Winter Sea Ice Advance BS Satellite	low	neutral	neutral	neutral	neutral
	Spring Sea Ice Retreat BS Satellite	low	neutral	neutral	neutral	neutral
	Spring Summer Temperature Surface SEBS Satellite	high	high	neutral	neutral	neutral
	Summer Temperature Bottom SEBS Model	high	neutral	neutral	neutral	neutral
Lower Trophic	Spring Chlorophyll a Peak SEBS Satellite	low	neutral	neutral	neutral	neutral
	Summer Euphausiid Abundance EBS Survey	NA	NA	NA	neutral	NA
Upper Trophic	Summer Pacific Cod Condition Juvenile EBS Survey	neutral	NA	neutral	neutral	neutral
	Summer Pacific Cod Condition Adult EBS Survey	neutral	NA	neutral	neutral	neutral
	Summer Pacific Cod Center Gravity East EBS Model	<i>high</i>	neutral	neutral	neutral	<i>high</i>
	Summer Pacific Cod Center Gravity North EBS Model	high	neutral	high	neutral	neutral
	Summer Pacific Cod Area Occupied EBS Model	neutral	NA	neutral	neutral	neutral
	Annual Arrowtooth Biomass EBS Model	neutral	high	high	high	NA

Ecosystem Considerations

- The North Pacific Index increased to high signifying a weak Aleutian Low, high sea level pressure, warming sea surface temperatures, higher precipitation, increased downwelling, and generally calmer conditions.
- Winter sea-ice extent during the advance season decreased to below average and is similar in extent to 2020, while ice extent during the retreat season remains just below average increasing steadily since 2020.
- Spring and summer surface temperature decreased to average conditions and bottom temperature continued to decrease from 2022 and is now similar to 2006 and 2011 values.
- Spring bloom peak timing was average, but bloom timing varies spatially and match would be dependent on spawning and movement of the Pacific cod population.
- Condition for juvenile Pacific cod remained above average, while adult condition decreased to below average.
- Center of gravity estimates suggest the Pacific cod population has moved southeast from 2022, with above average area occupied, similar to the 2011 survey.
- Arrowtooth flounder biomass has steadily increased over the time series and remains high from the most recent stock assessment model in 2022, with an 11% decrease in the 2023 EBS shelf bottom trawl survey.



Socioeconomic Indicators



Explorations: environmentally linked fishery-dependent data (Watson and Callahan, 2021)



Socioeconomic Summary Table

Category	Indicator	2019 Status	2020 Status	2021 Status	2022 Status	2023 Status
Economic	Annual Pacific Cod Real Exvessel Value EBS Fishery	neutral	neutral	low	neutral	NA
	Annual Pacific Cod Real Exvessel Price EBS Fishery	neutral	neutral	neutral	neutral	NA
	Annual Pacific Cod Real Revenue Per Unit Effort EBS Fishery	high	neutral	neutral	neutral	NA



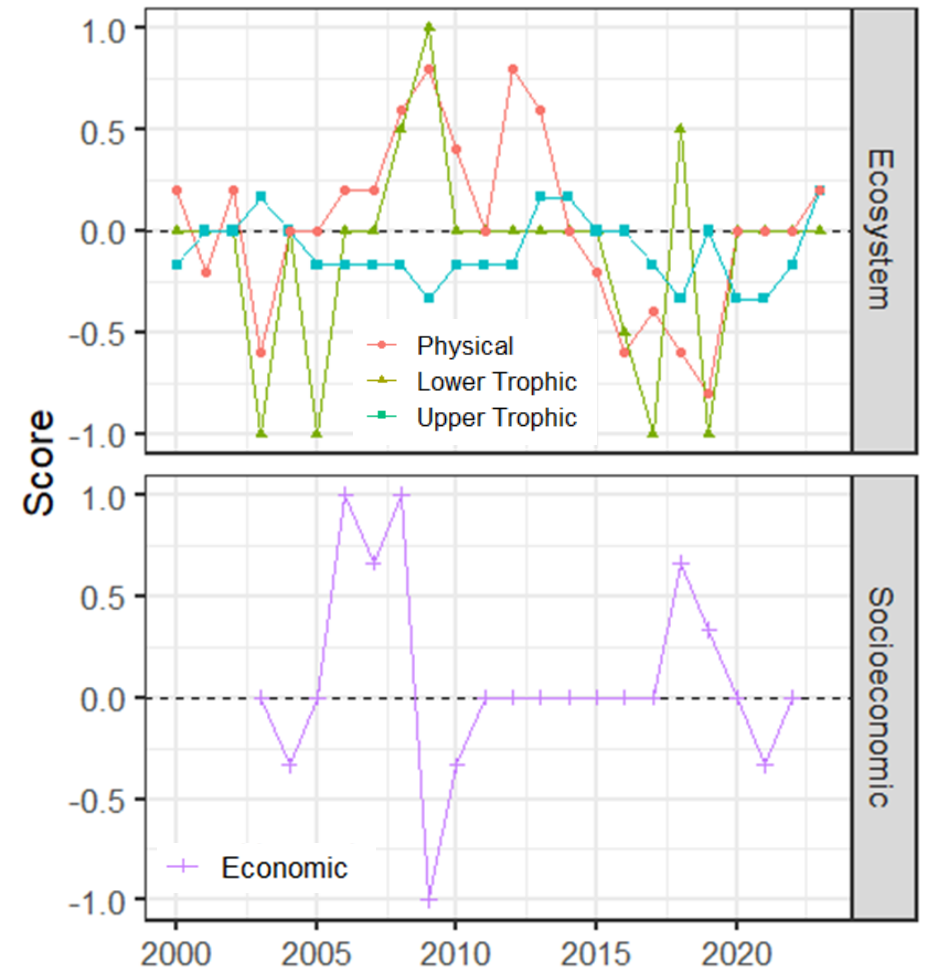
Socioeconomic Considerations

- Ex-vessel value increased from low to below average in 2022 but still among lowest levels since 2011.
- Price per pound and revenue-per-unit-effort reversed recent declining trend and increased to average in 2022.



Indicator Monitoring Analysis: Overall Score

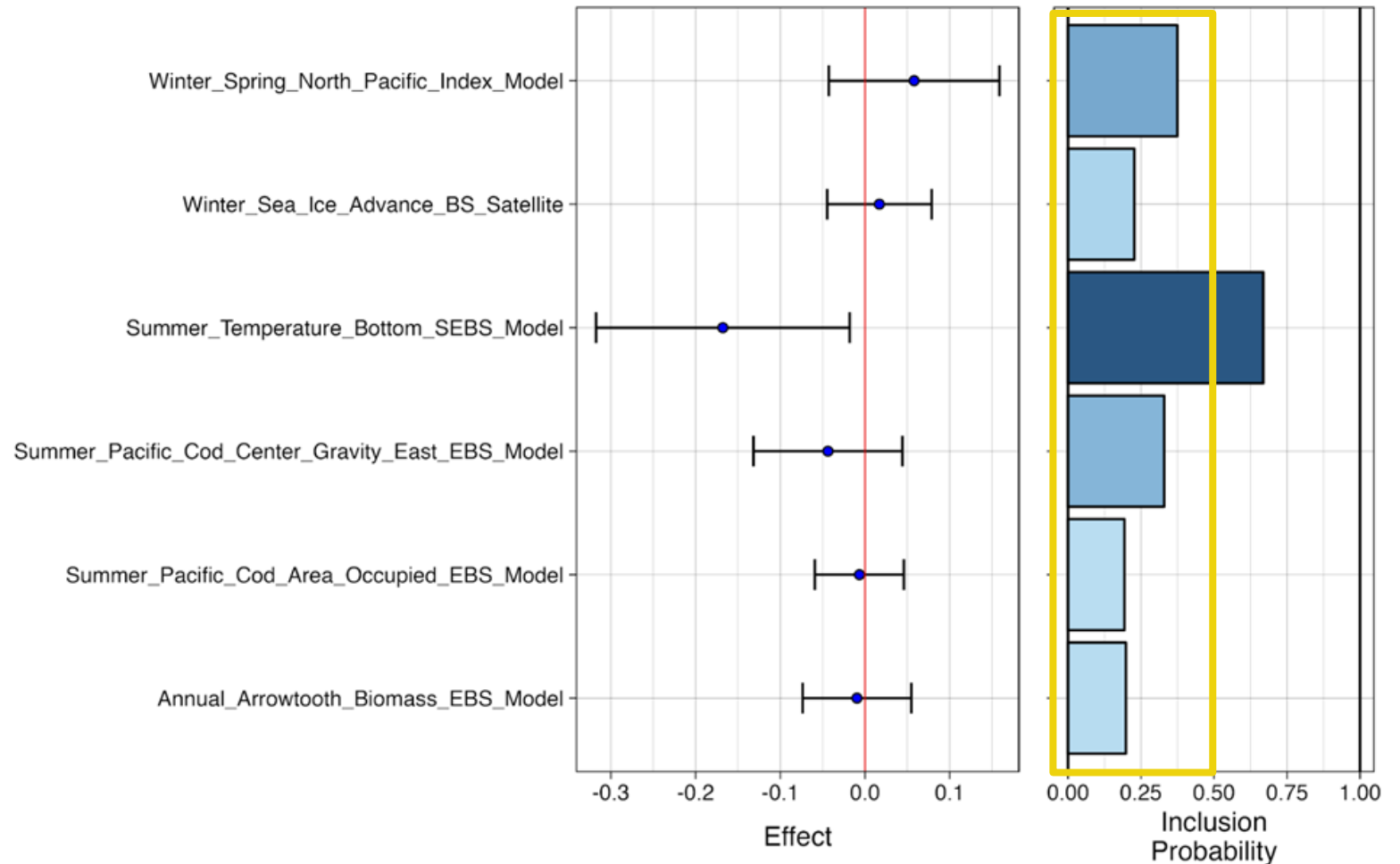
- Ecosystem (12 of 13 total)
 - Physical > to above average
 - Lower trophic remained average
 - Upper trophic > to above average
- Socioeconomic (3 of 3 total)
 - Economic > to average



Indicator Monitoring Analysis: Importance Test

One indicator with importance > 0.5 , same:

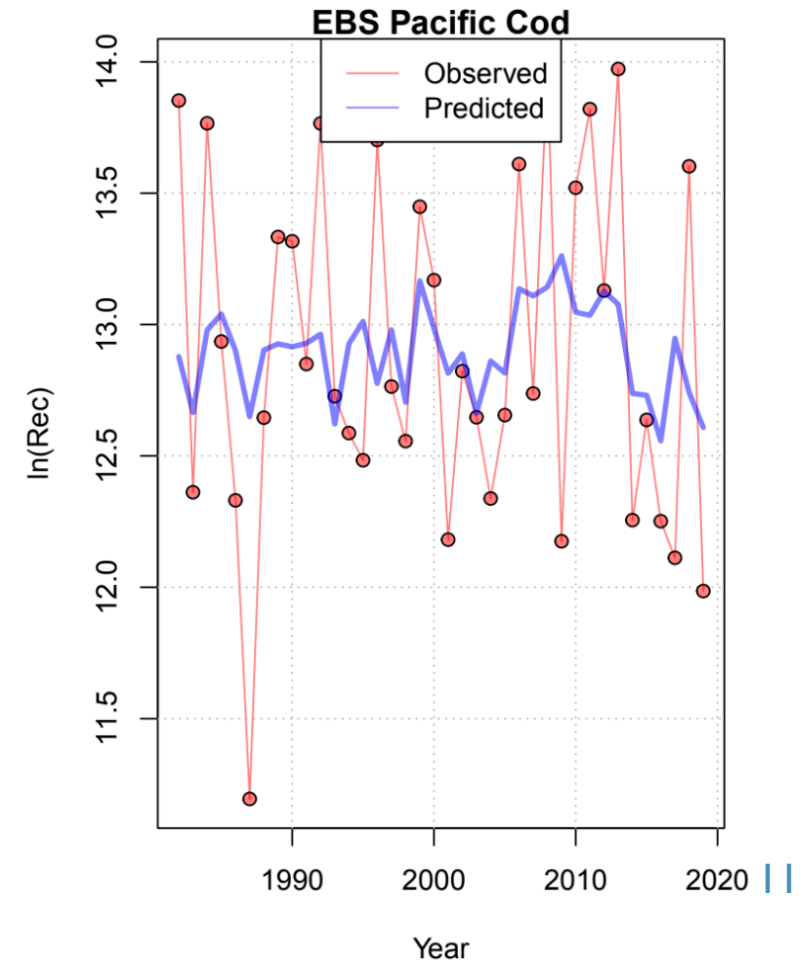
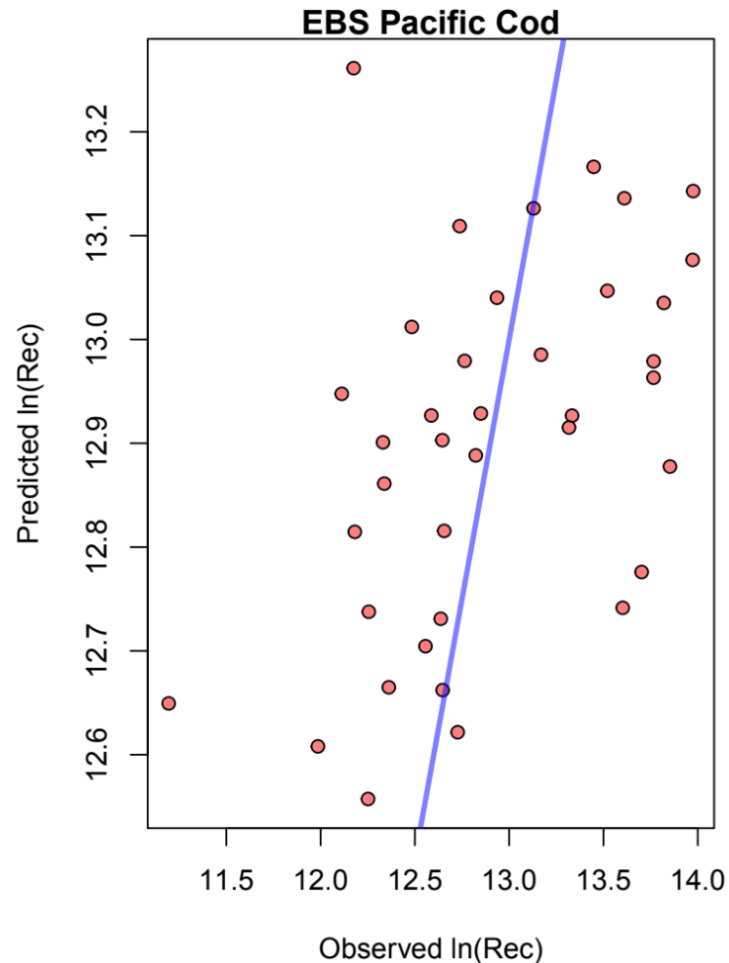
- Summer bottom temperature SEBS from ROMS
- 1985-2019 year class



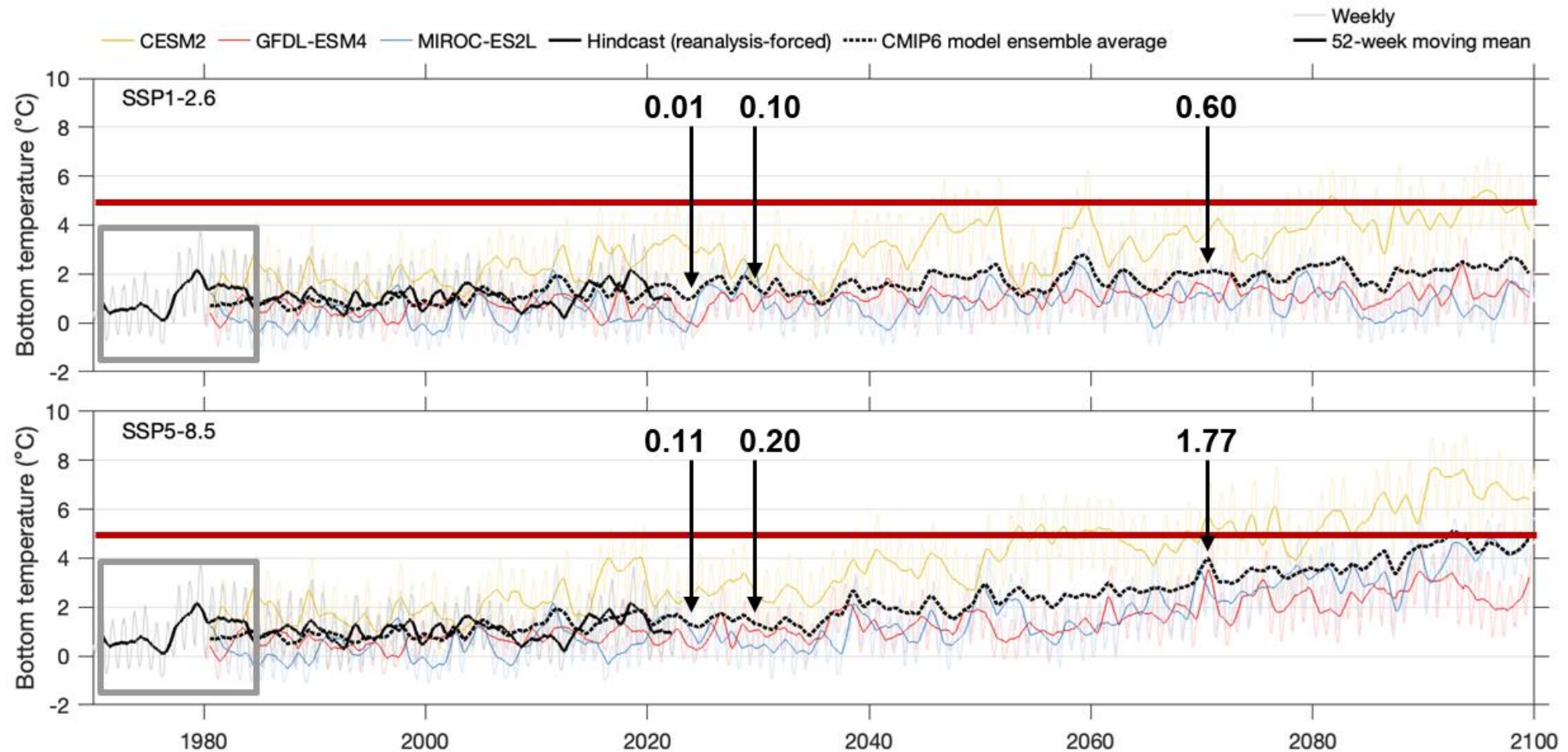
Indicator Monitoring Analysis: Importance Test

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Climate Explorations



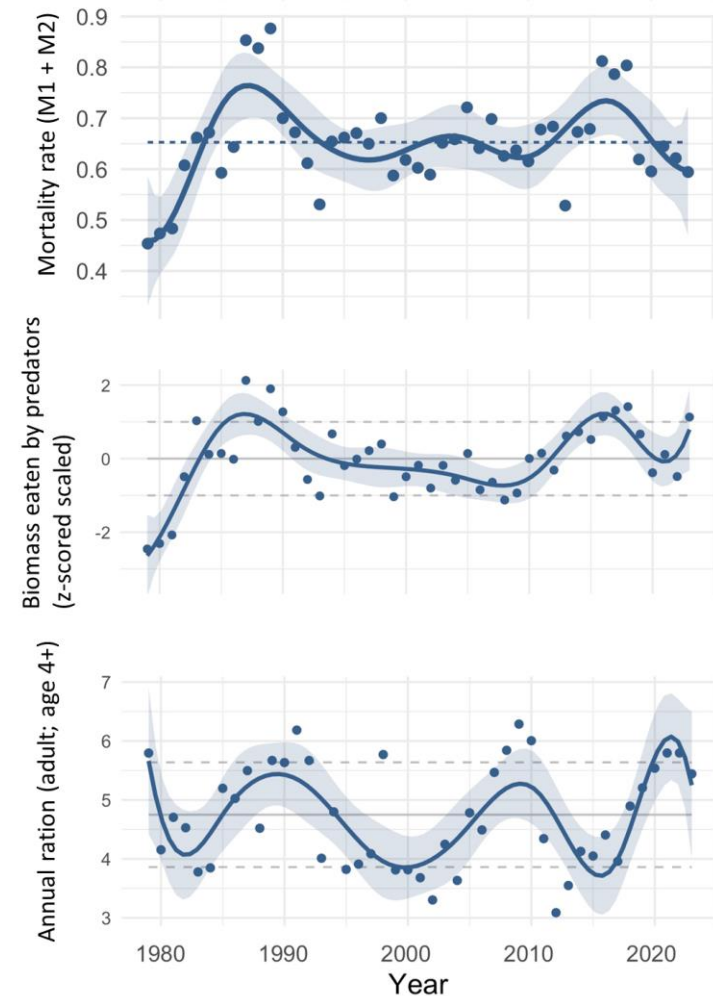
Indicator Monitoring Analysis: Advanced Test

■ CEATTLE

- Multi-species model of Pacific cod, pollock and arrowtooth
- Based in part on most recent stock assessment model, 1979-present

■ Results

- Age-I M < below average, biomass consumed > to above average, ration < but still above average





Planned ESP Developments

- 1) Request for Indicators (RFI) in 2024, use ESP data gaps and research priorities list, indicators submitted in January, reviewed in February by ESP teams
- 2) Consider how to use the EBS R-CEATTLE model output in the ESP to identify other indicators for monitoring, evaluate predation M or bioenergetics indicators to compare with the VAST condition in RFI
- 3) Socioeconomic indicators evaluation with several groups, also part of the National ESP Initiative

Questions?



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Ecosystem & Socioeconomic Profile (ESP) Highlights – EBS Pacific Cod



- Management Summary:

- Sea ice advance and retreat below average, surface temperatures average and bottom temperature below average, calmer cooler conditions
- Spring bloom timing average but match depends on spawning and movement of Pacific cod
- Condition of juveniles above average, adult below average, suggesting sufficient prey, population continues to move southeast, and more spread out
- Arrowtooth biomass has steadily increased over time, near time series peak
- Ex-vessel value increased but still below average, price and revenue/effort increased to average in 2022

- Modeling Summary:

- One potential covariate for recruitment, summer bottom temperature from ROMS-NPZ model, 1985-2019 year class
- CEATTLE model update: age-1 M decreased remains below mean, total biomass consumed above average, ration decreased but still above average

